

Effects of Experimental Flow on Lotic Fish Reproduction



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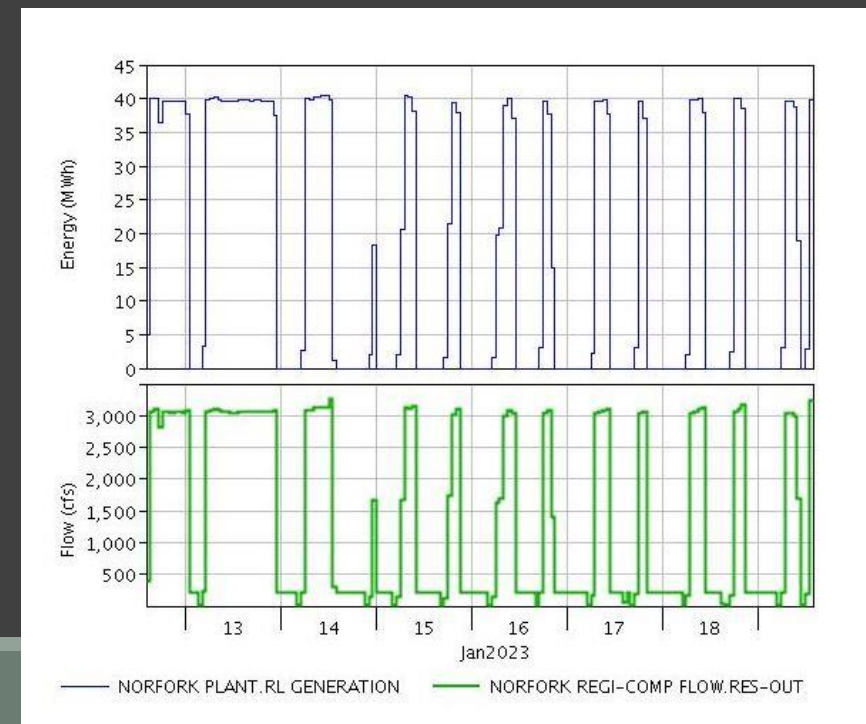
Introduction

- Large rivers are dynamic ecosystems
 - Ecologically complex
 - High fish diversity
- Significantly altered and remodeled for human usage
 - Changes natural flow regime



Introduction

- Construction of dams alters river flow
- Reservoir releases highly regulated
 - Discharge highly variable
 - Changes timing of flow events
 - Temperature regimes altered
 - Influences fish reproduction



Fish Spawning

- Flow dynamics important for initiating spawning movement
 - Increased flow stimulates activity
 - Spawn during certain seasons
- Different species use different environmental conditions as spawning cue



Sustainable Rivers Program

- Manipulate flow to benefit downstream fishes
- Different responses by different fish species
 - Difficult to benefit all fish species
- Flows attenuate downstream



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Objectives

- Determine response of fish production in relation to environmental factors
- Determine spatiotemporal distribution of larval fish densities

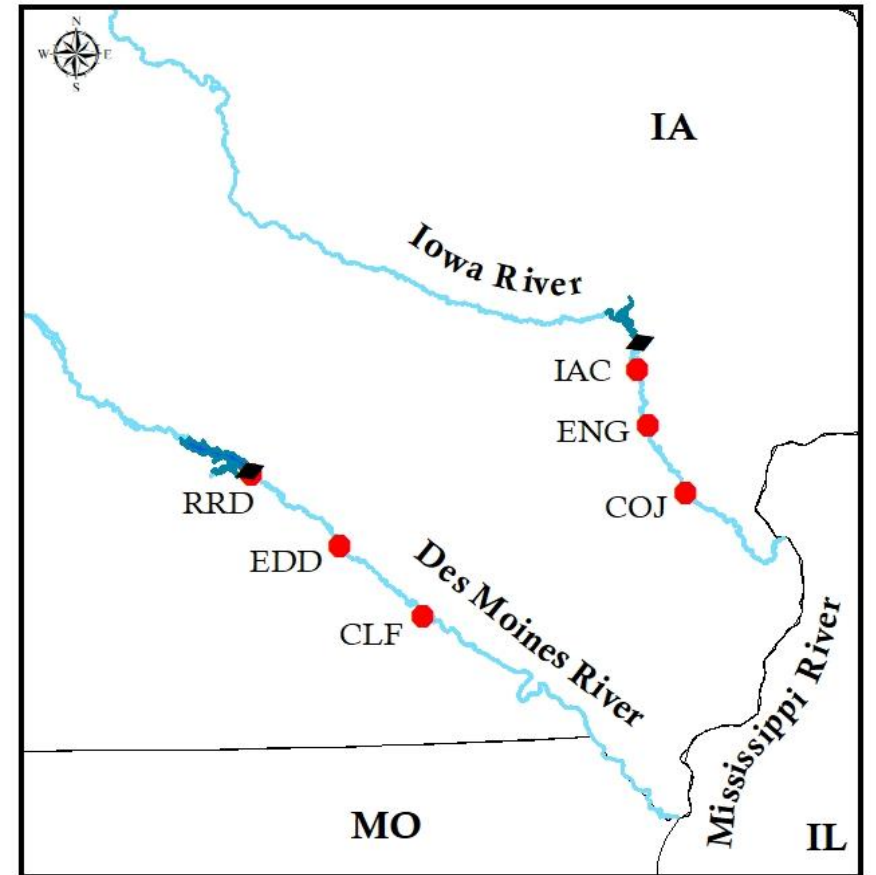
Study Area

Experimental Site: Des Moines River

- Red Rock Dam (RRD)
- Eddyville (EDD)
- Cliffland (CLF)

Reference Site: Iowa River

- Iowa City (IAC)
- English River Confluence (ENG)
- Columbus Junction (COJ)



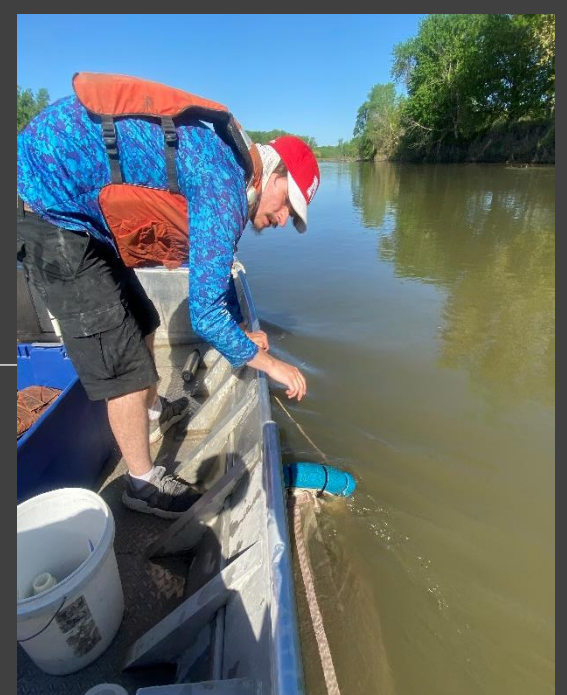
Legend

- ◼ Dam
- Sites
- Reservoirs
- Rivers

0 10 20 40 60 80 Kilometers

Larval Fish Sampling

- April-June (2021-2022)
- Ichthyoplankton tows (0.5m diameter, 500 μ m mesh)
- General Oceanics Model (2030R flowmeter fixed to mouth of net
 - Measure water volume sampled
- Triplicate samples at each site
 - Backwater, thalweg, channel border
 - 4 minute tow duration
- Weekly sampling prior to flow pulse
- Every other day during flow pulse
- Returned to weekly sampling after flow pulse





Channel Border

Thalweg

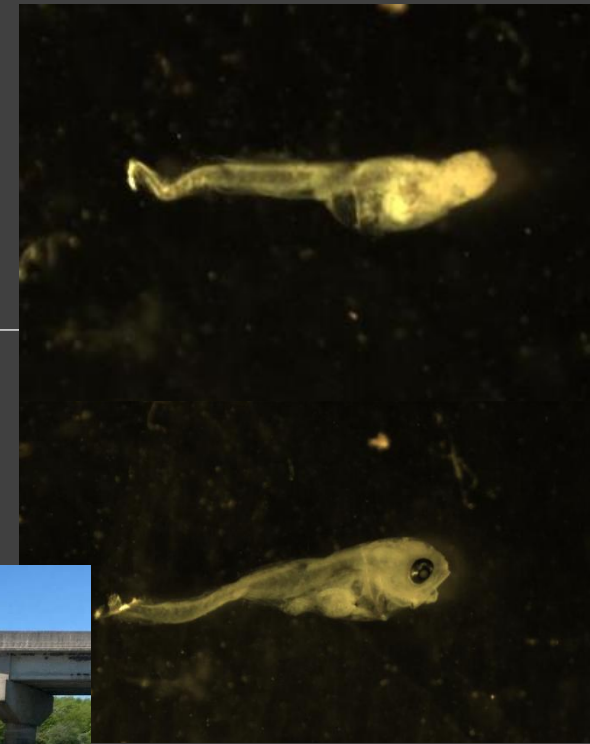
Backwater

River flow

River flow

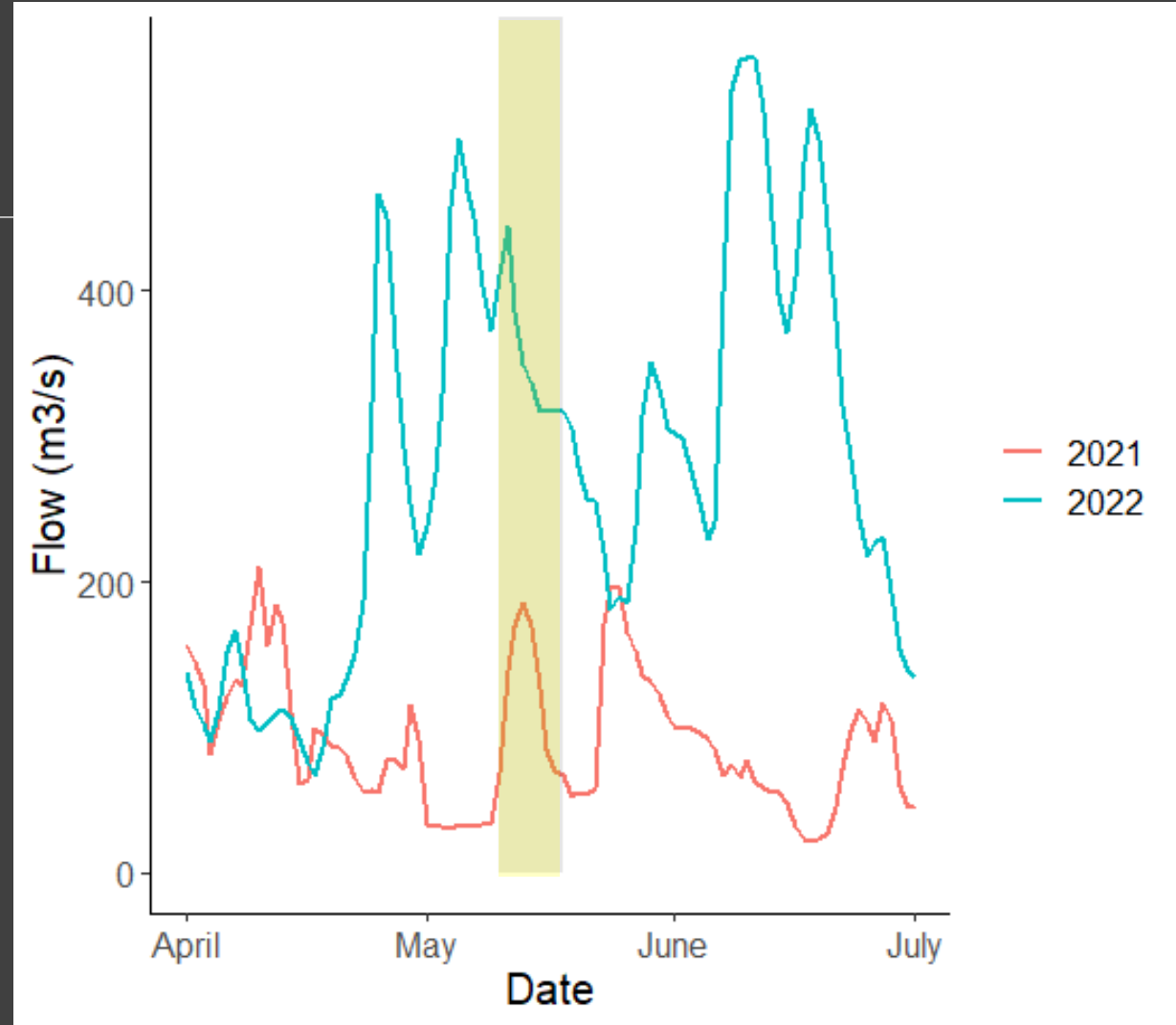
Larval Fish Sampling

- Larvae preserved in ethanol in the field
- Separated from debris
- Identified to lowest classification possible
 - Family or Genus
- Yolk sac and larval included for densities
 - Density= larvae/100m³ sampled
 - Average density for each site and day of capture



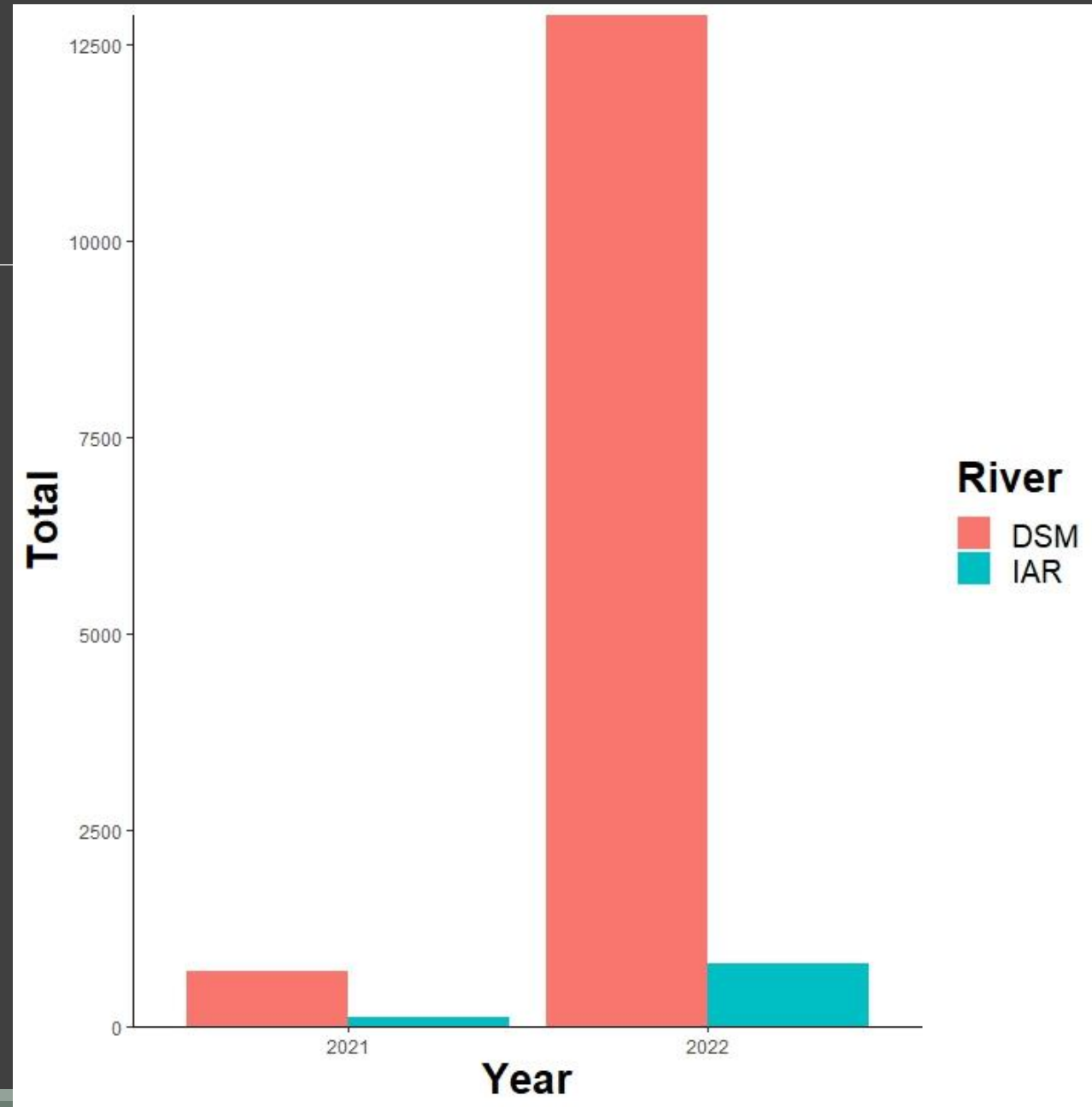
Experimental Flow

- Discharge from Red Rock Dam
 - Experimental Flow: Mid-Late May
 - 2021 and 2022

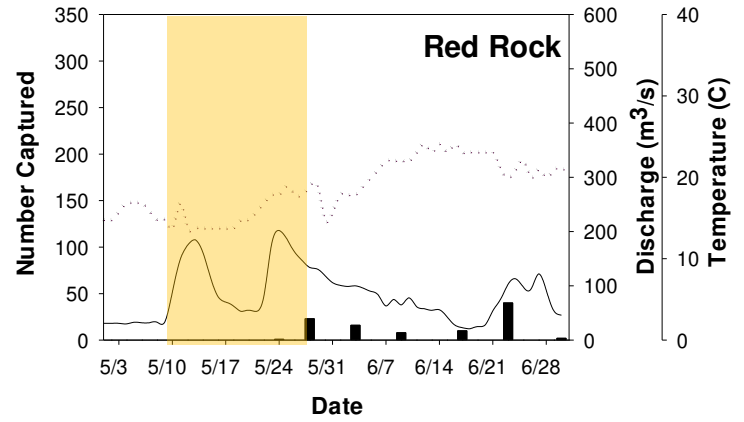


Larval Catches

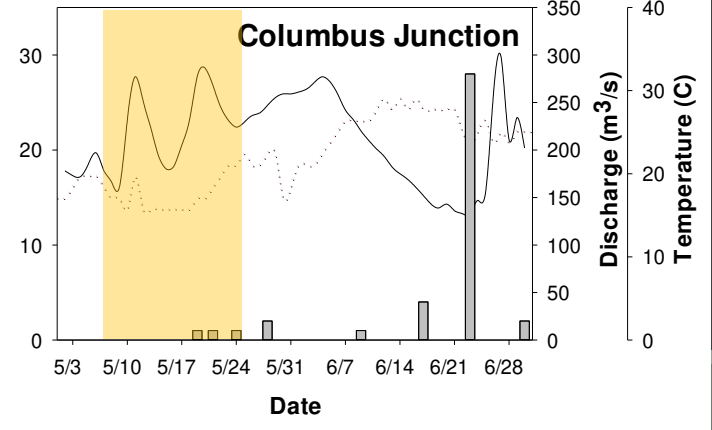
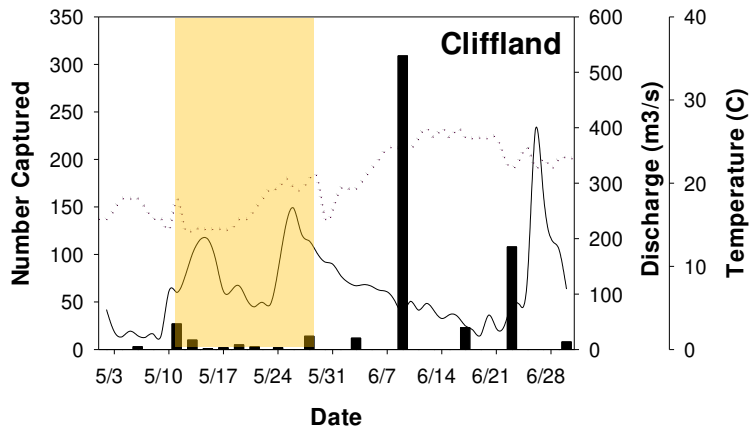
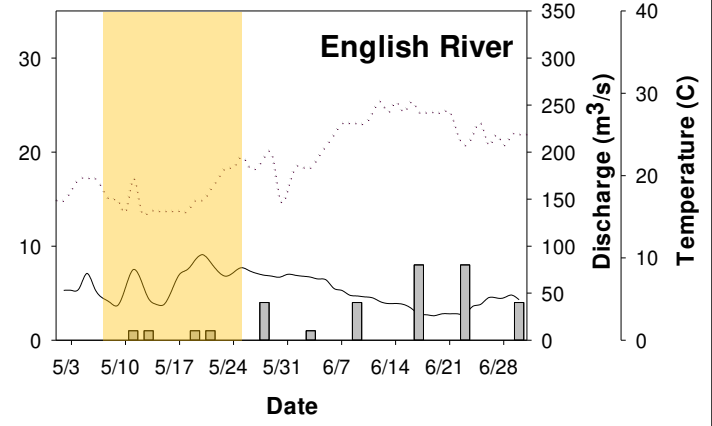
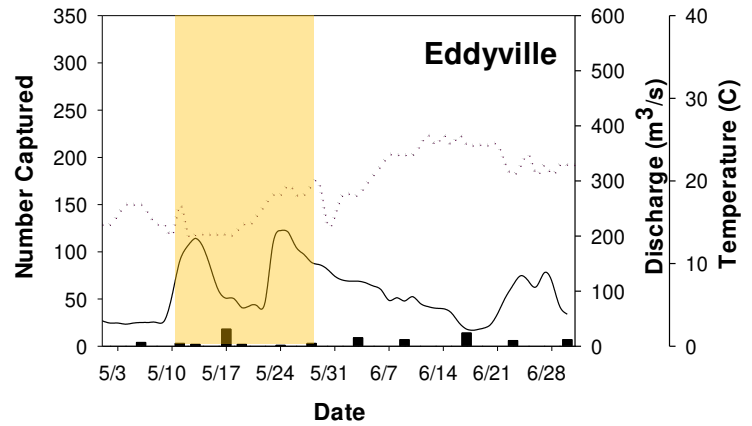
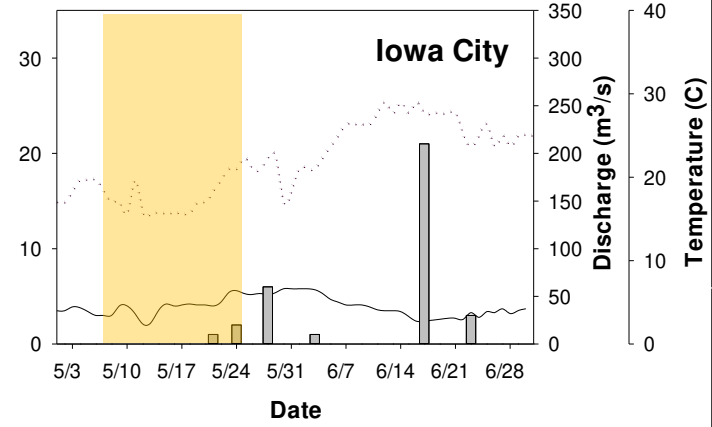
- Highest catches in 2022 for both rivers
 - Higher flow volume
 - Higher response for spawning



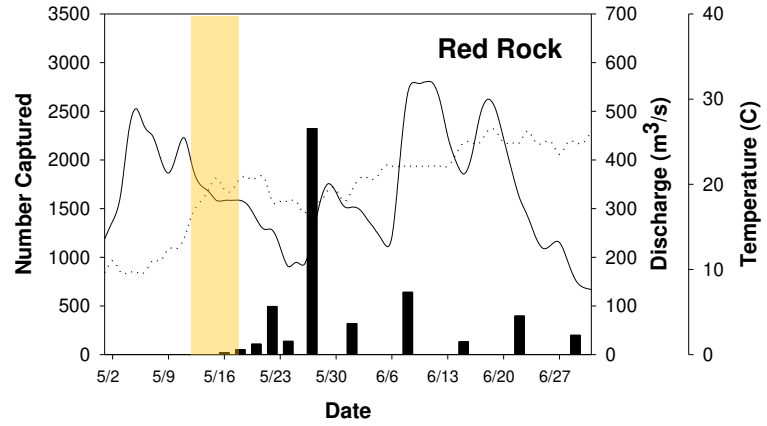
Des Moines 2021



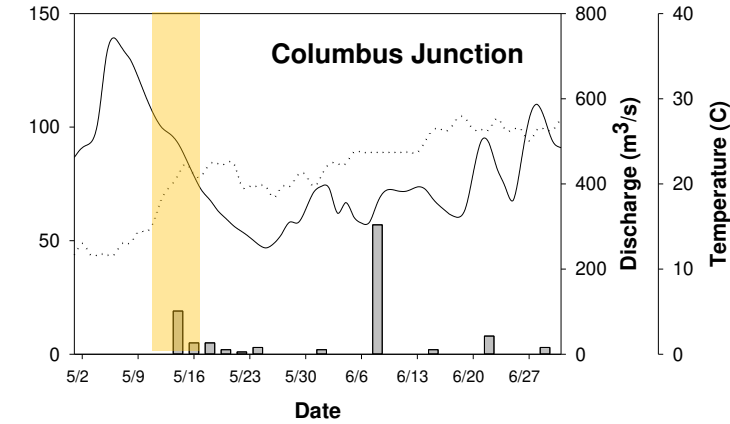
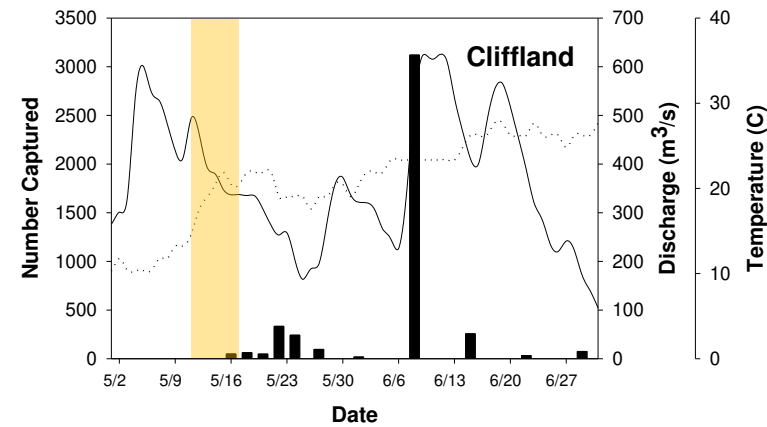
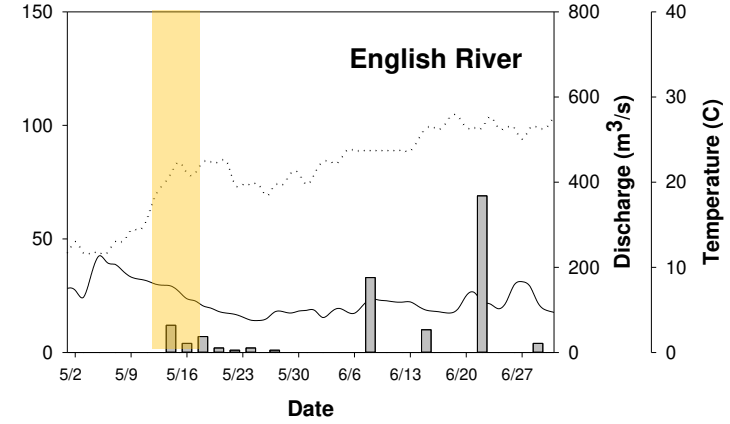
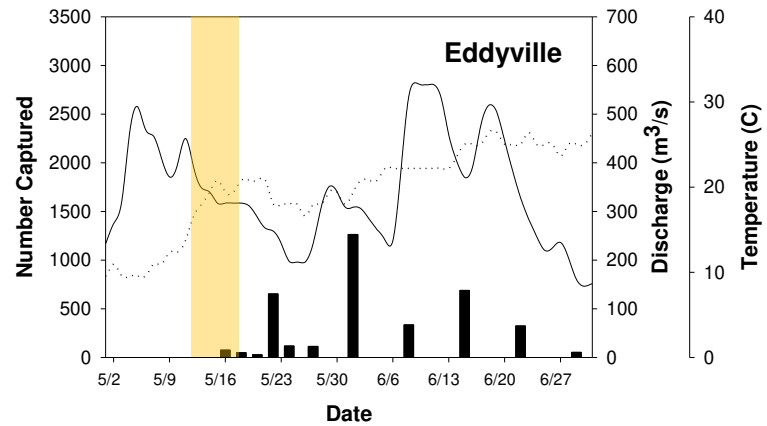
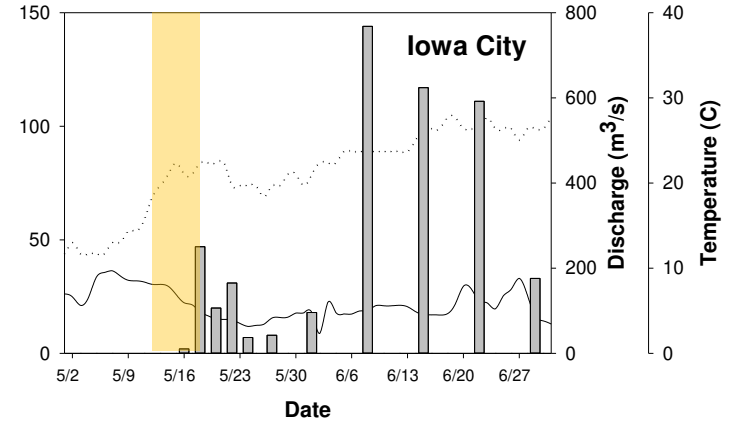
Iowa 2021



Des Moines 2022



Iowa 2022



Species of Interest

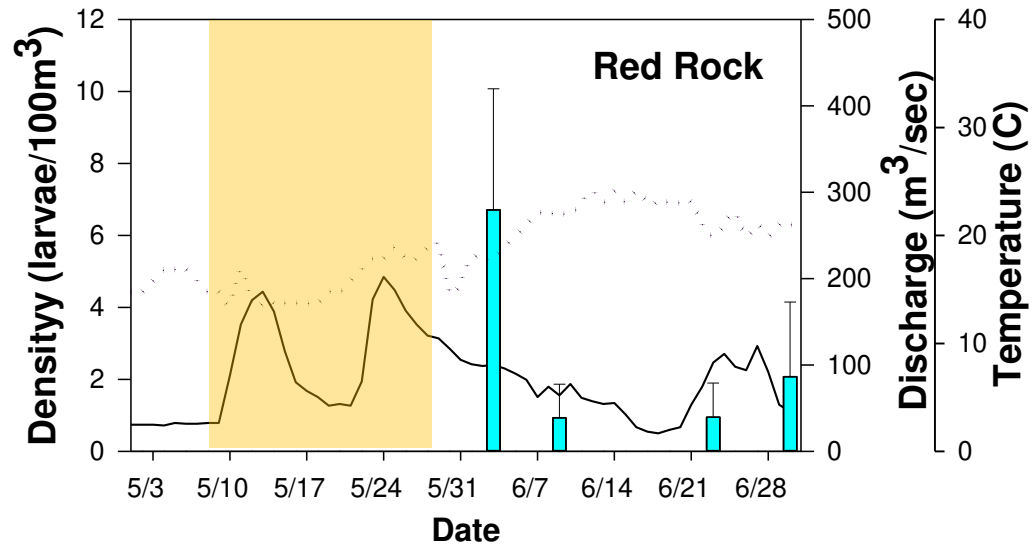
- Sciaenidae
- Cyprinidae
- Different spawning strategies environmental conditions



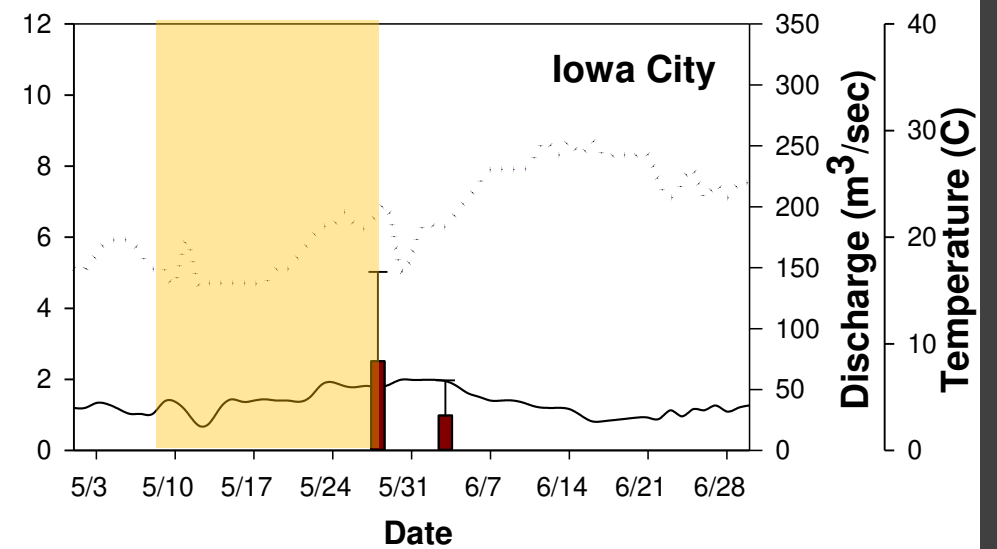
Sciaenidae



Des Moines 2021

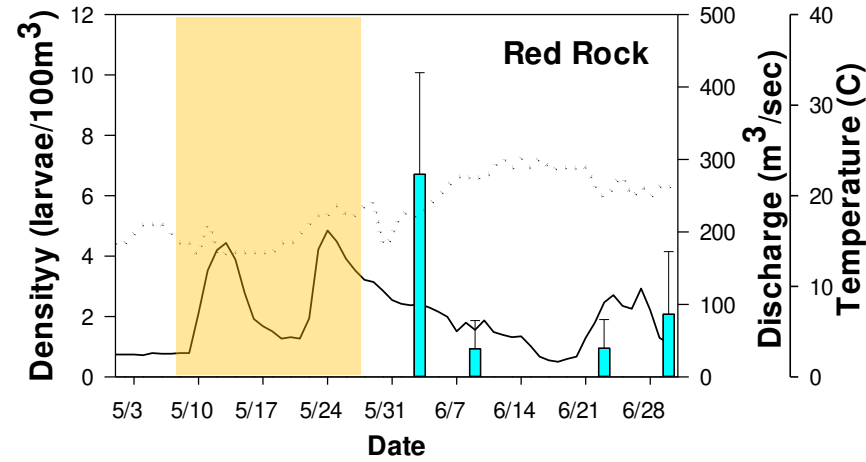


Iowa 2021

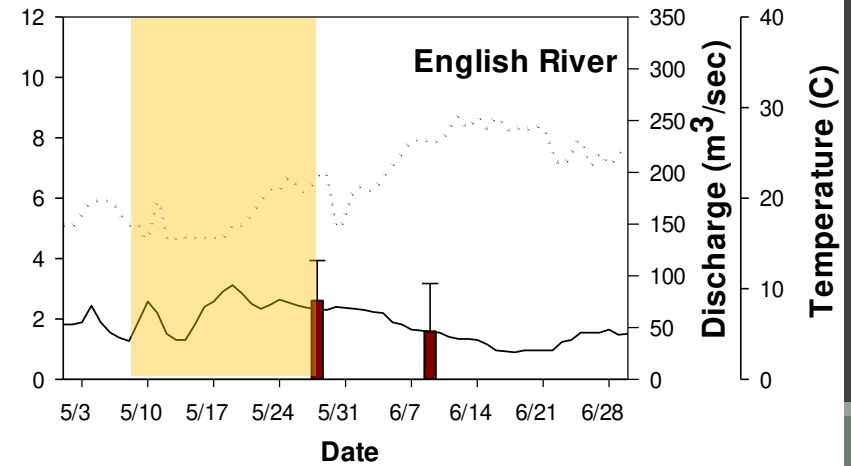
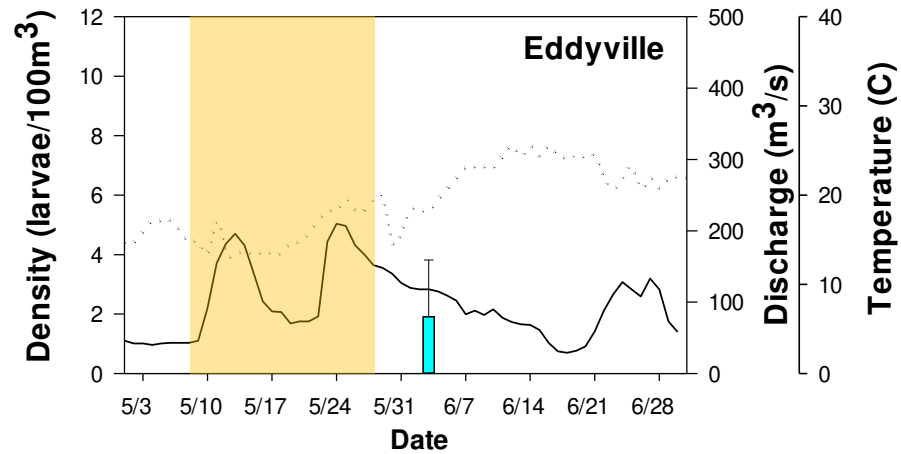
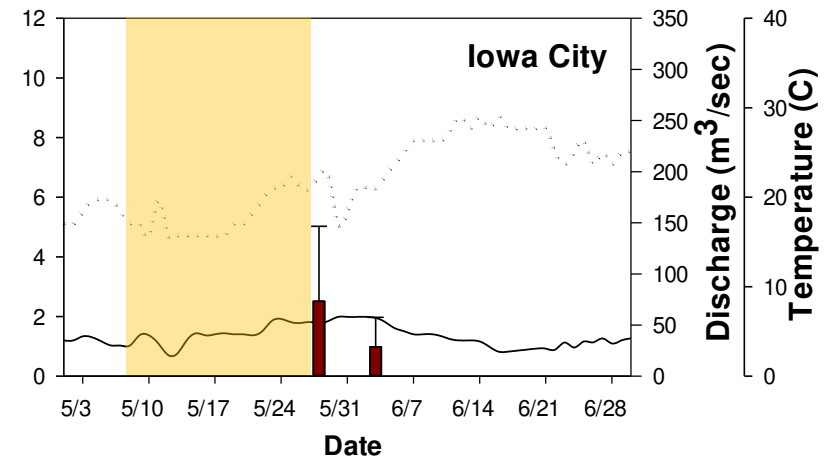




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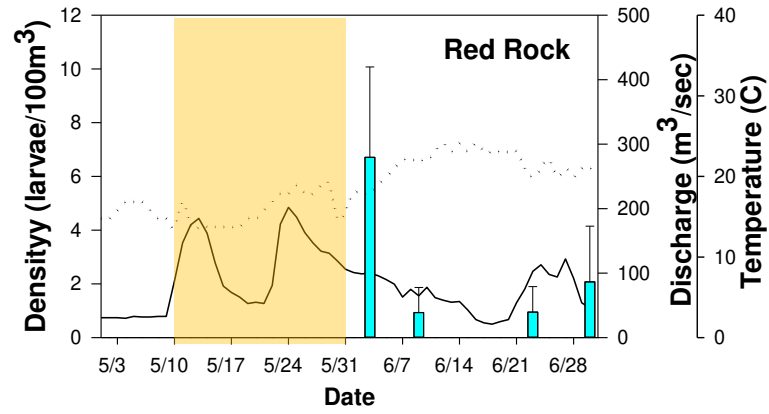


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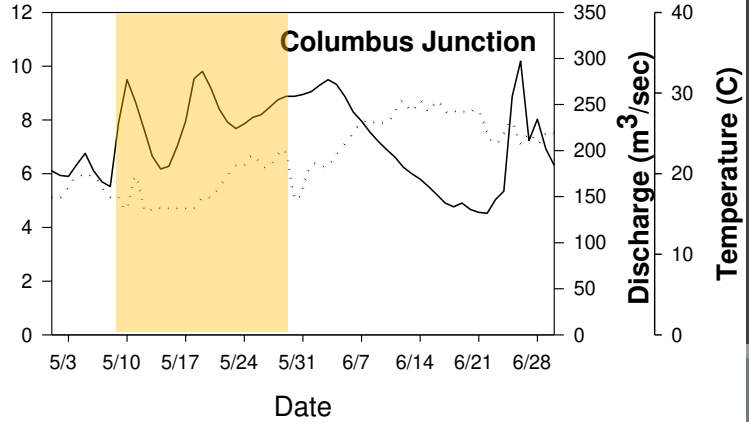
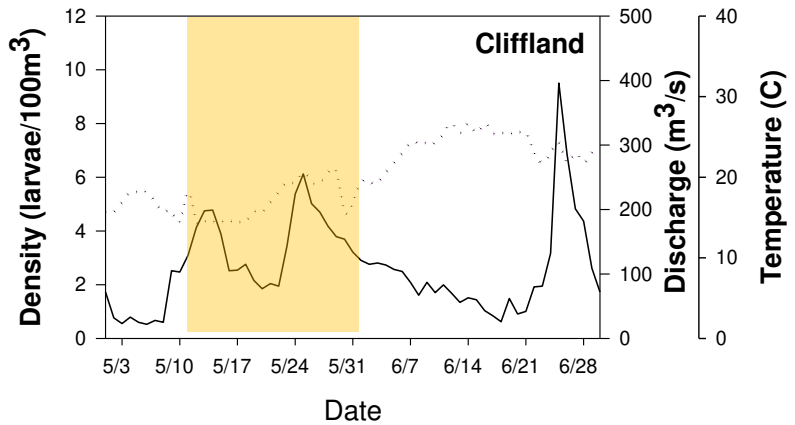
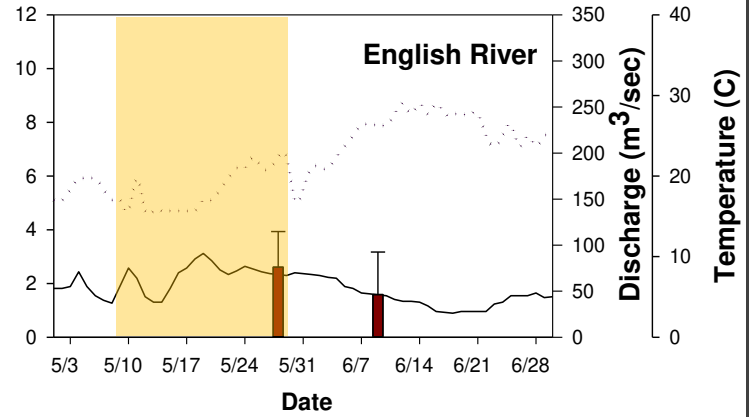
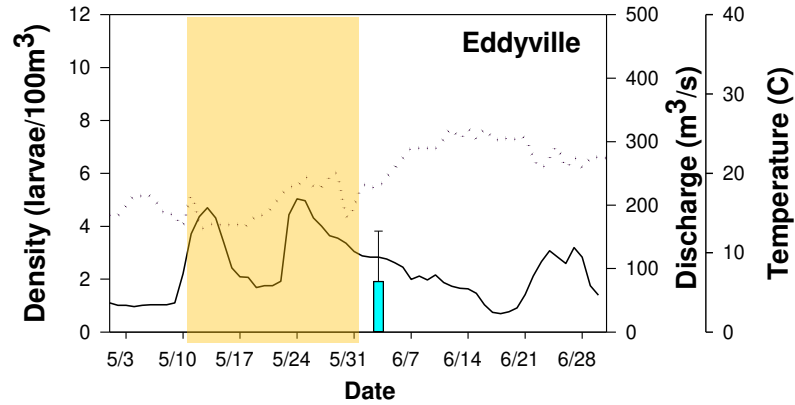
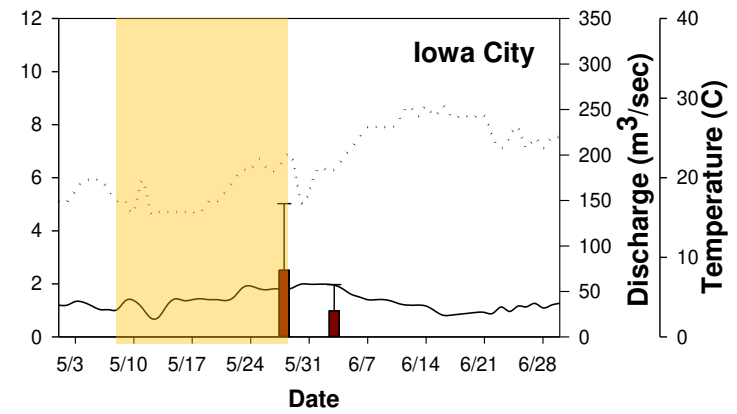




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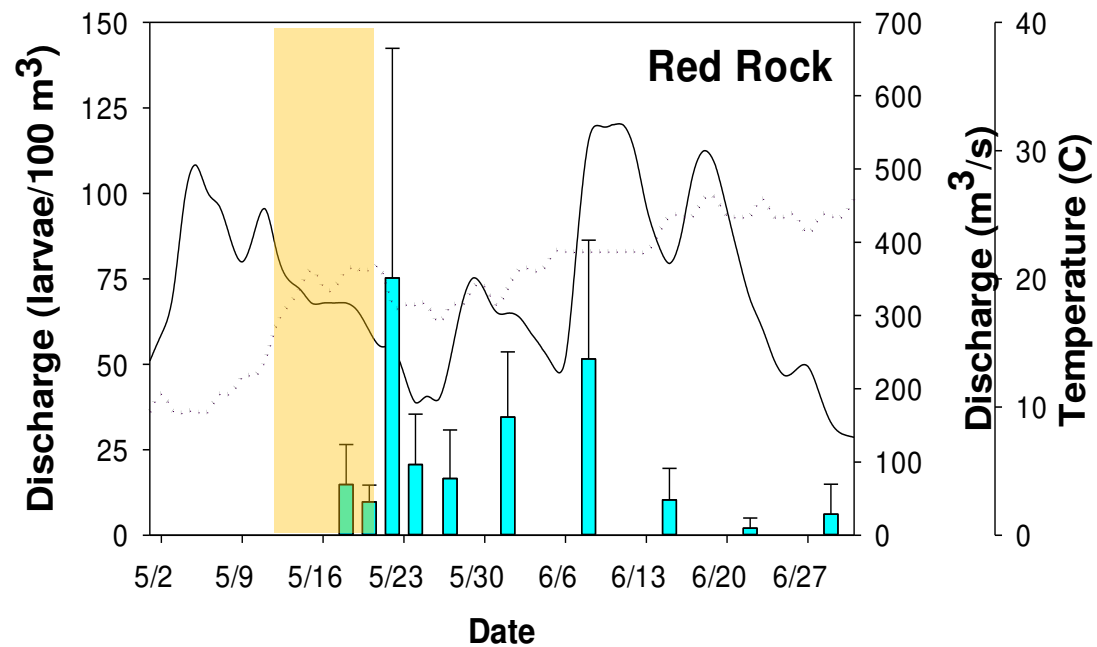


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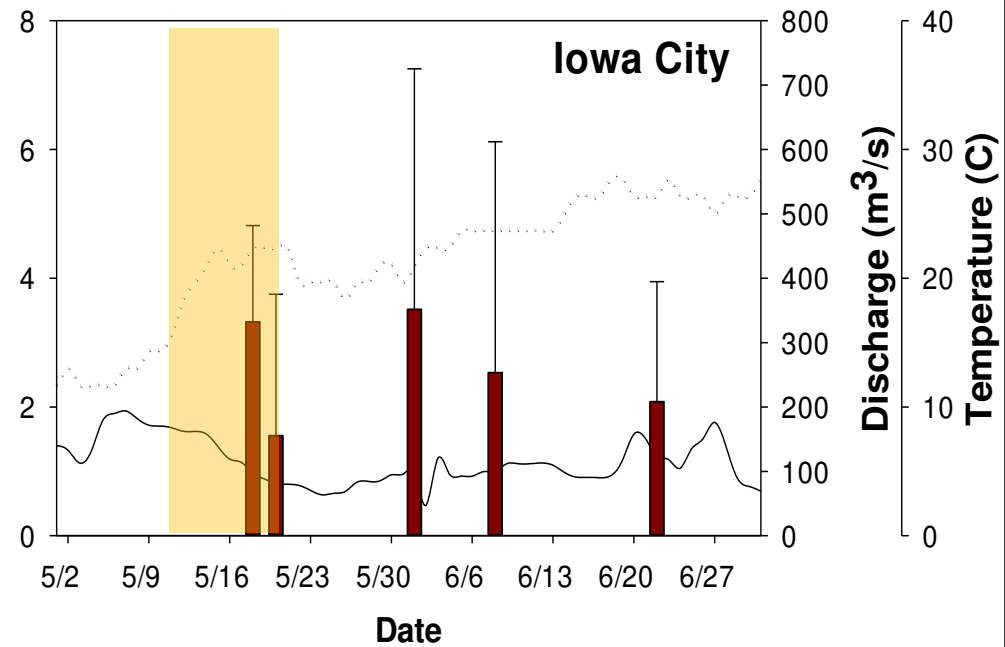




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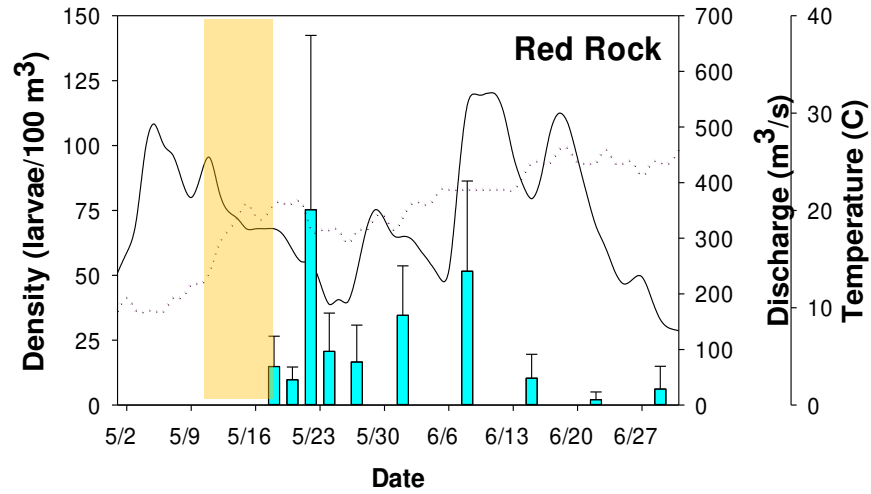


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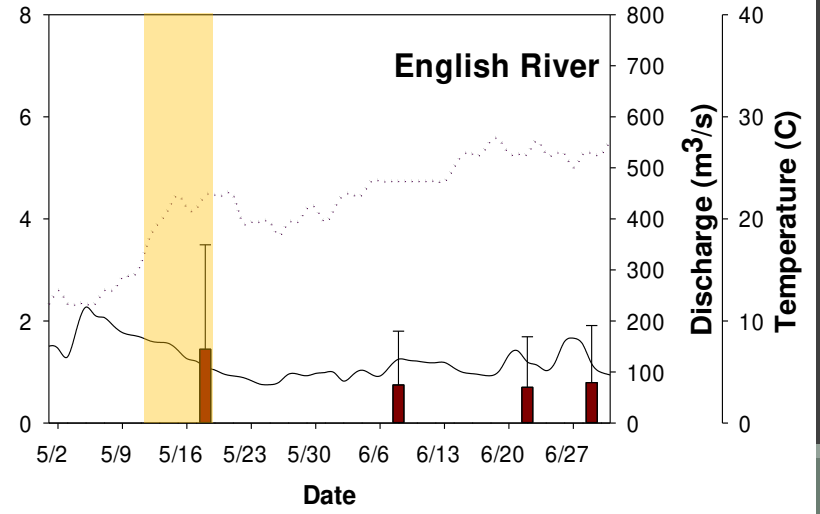
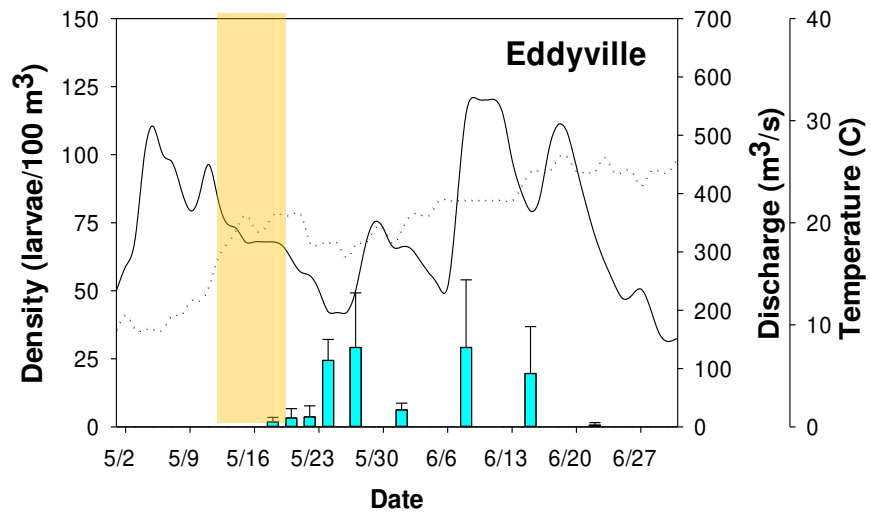
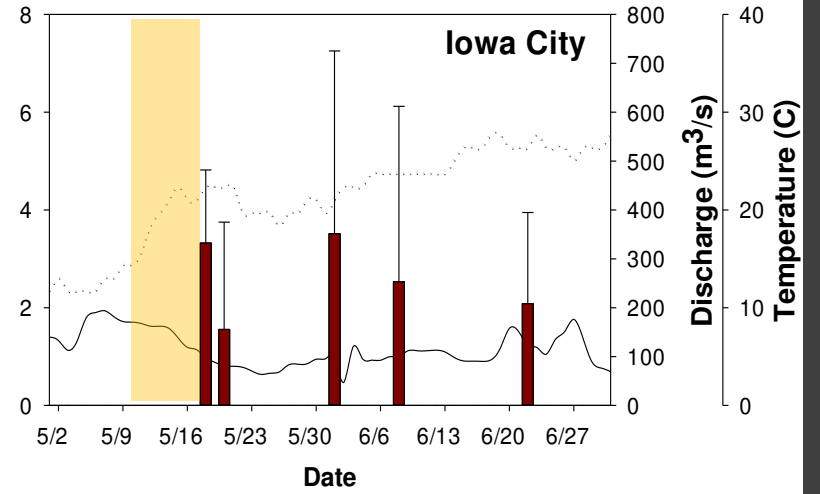




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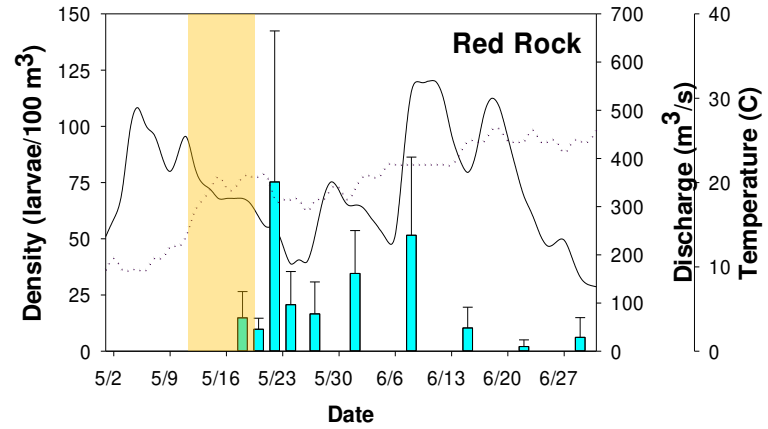


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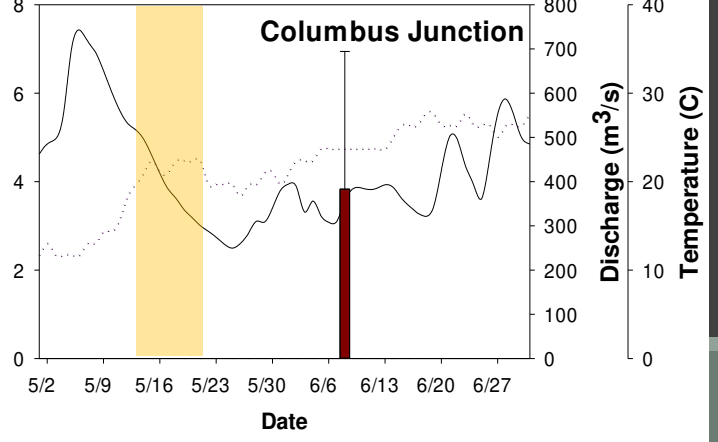
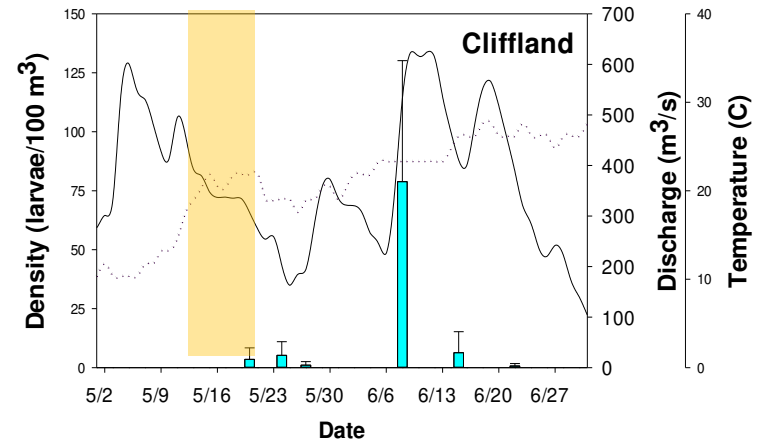
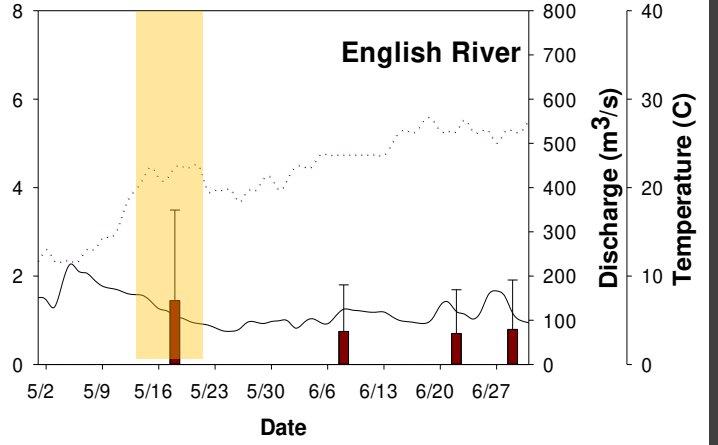
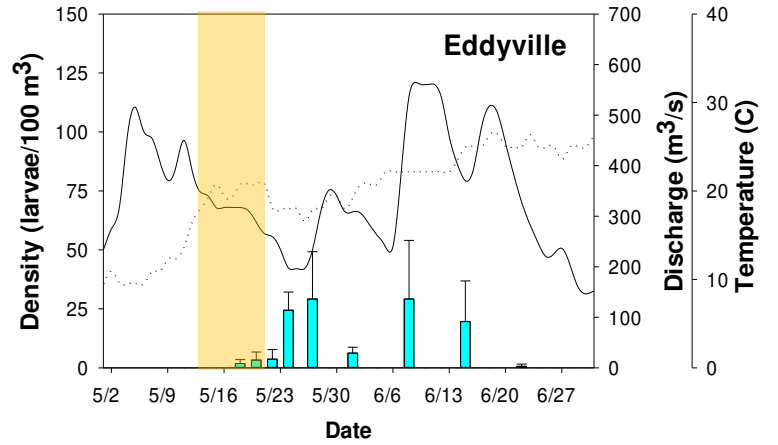
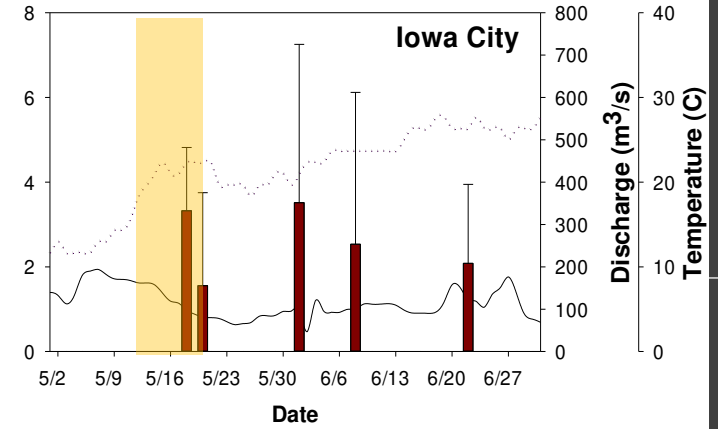




Des Moines 2022



Iowa 2022



How do Sciaenidae respond to environmental factors?

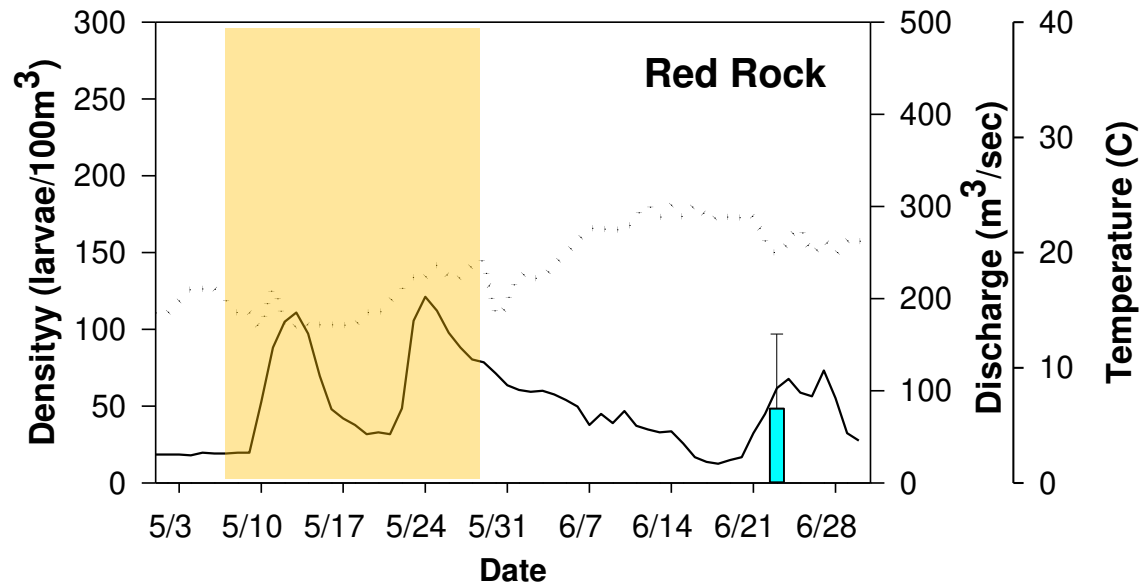


Species	Discharge	Temperature
Sciaenidae	+ ↑	+ ↑
Cyprinidae		

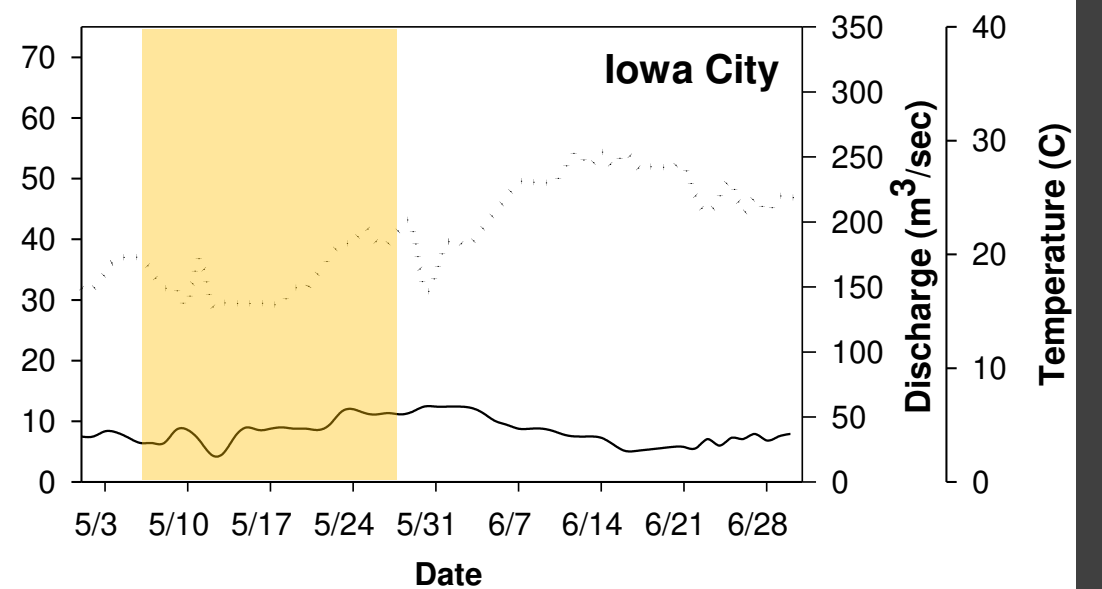
Cyprinidae



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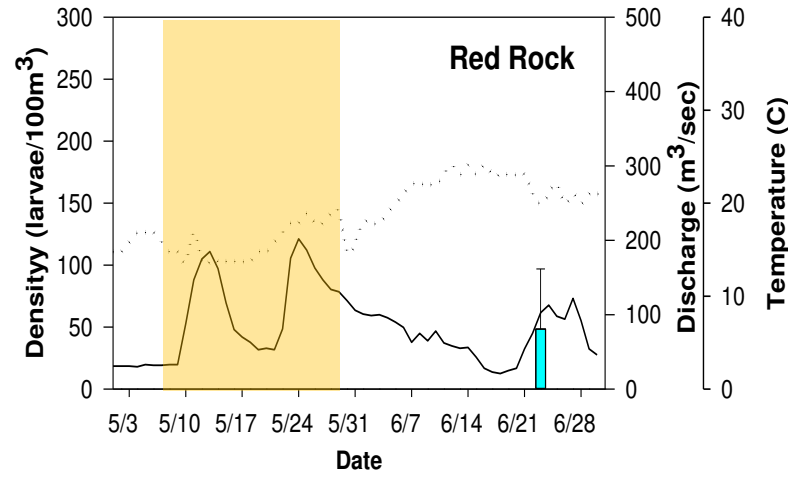


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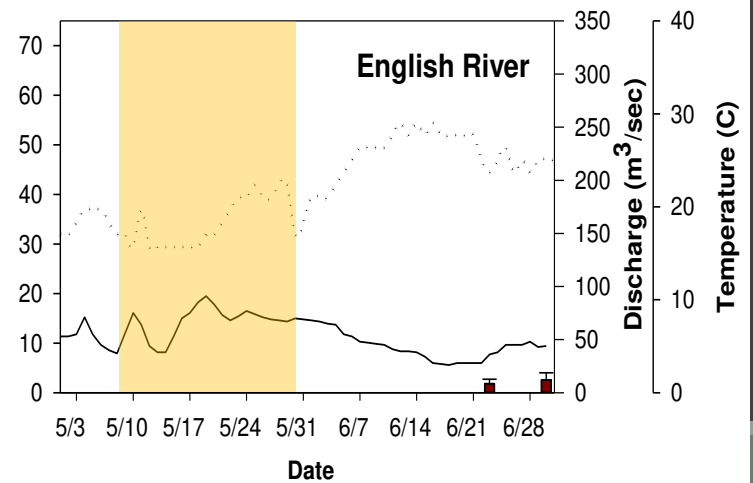
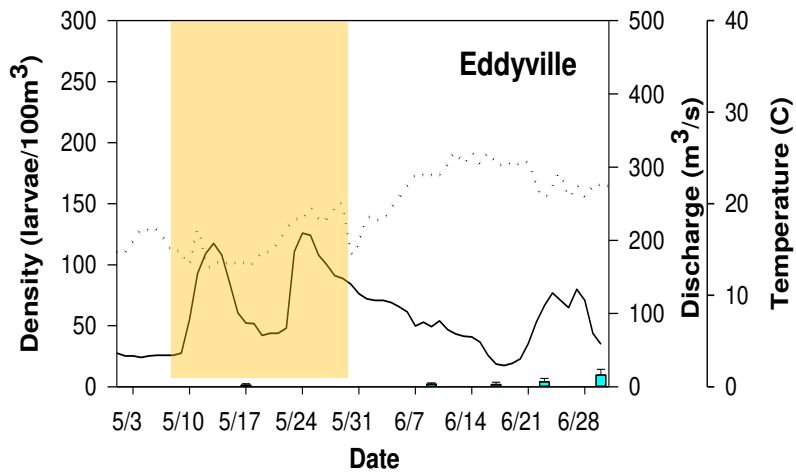
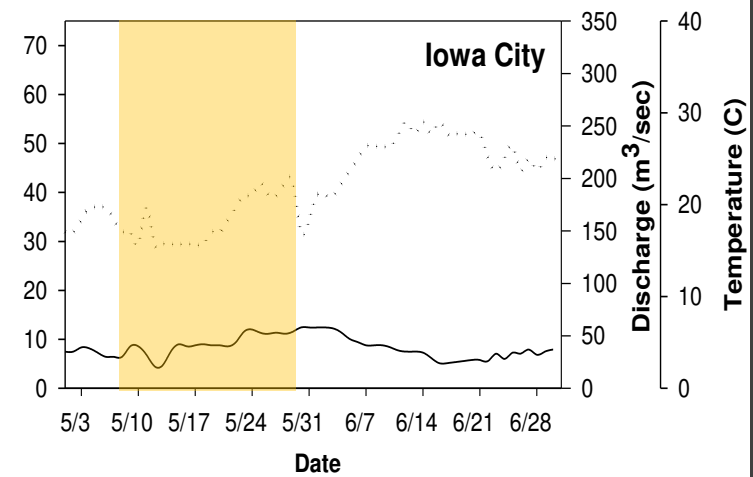




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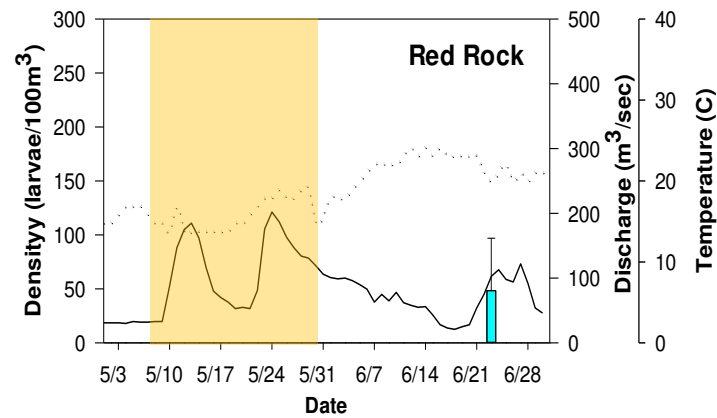


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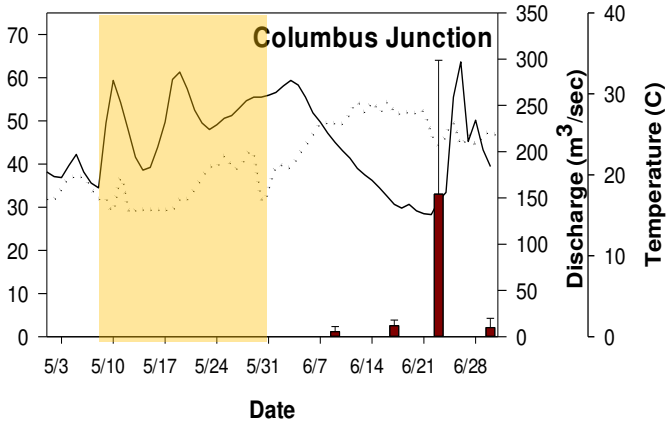
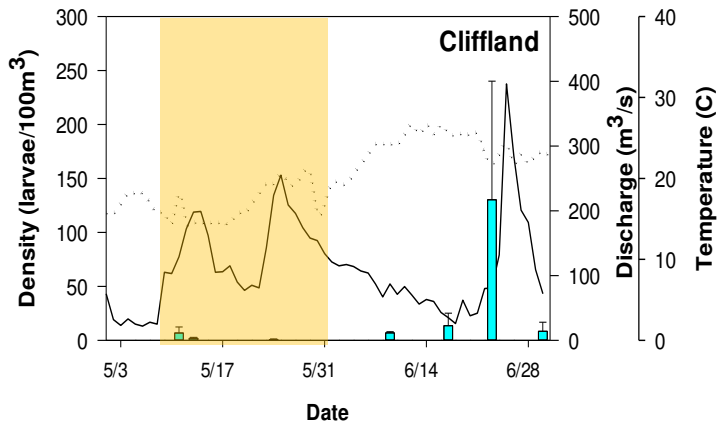
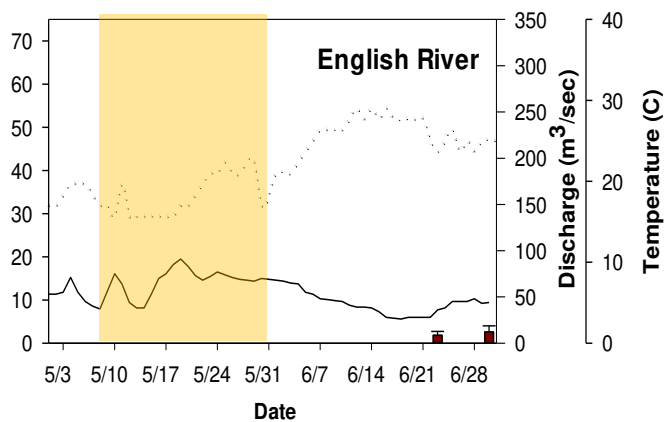
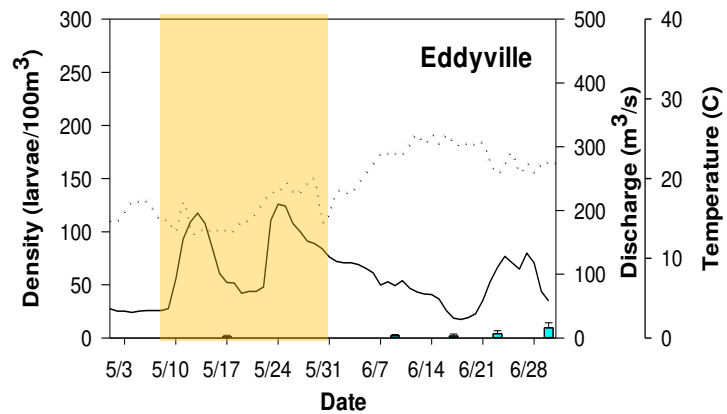
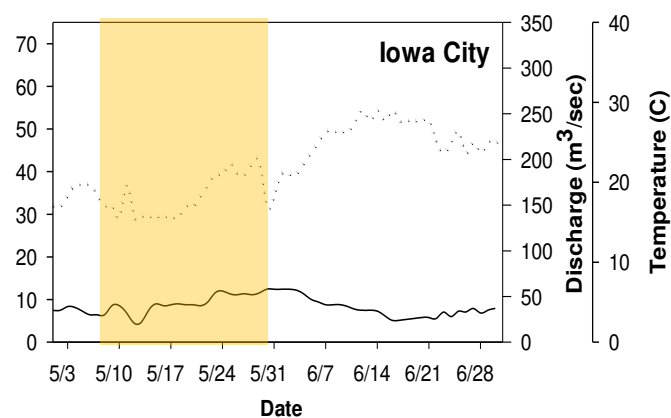


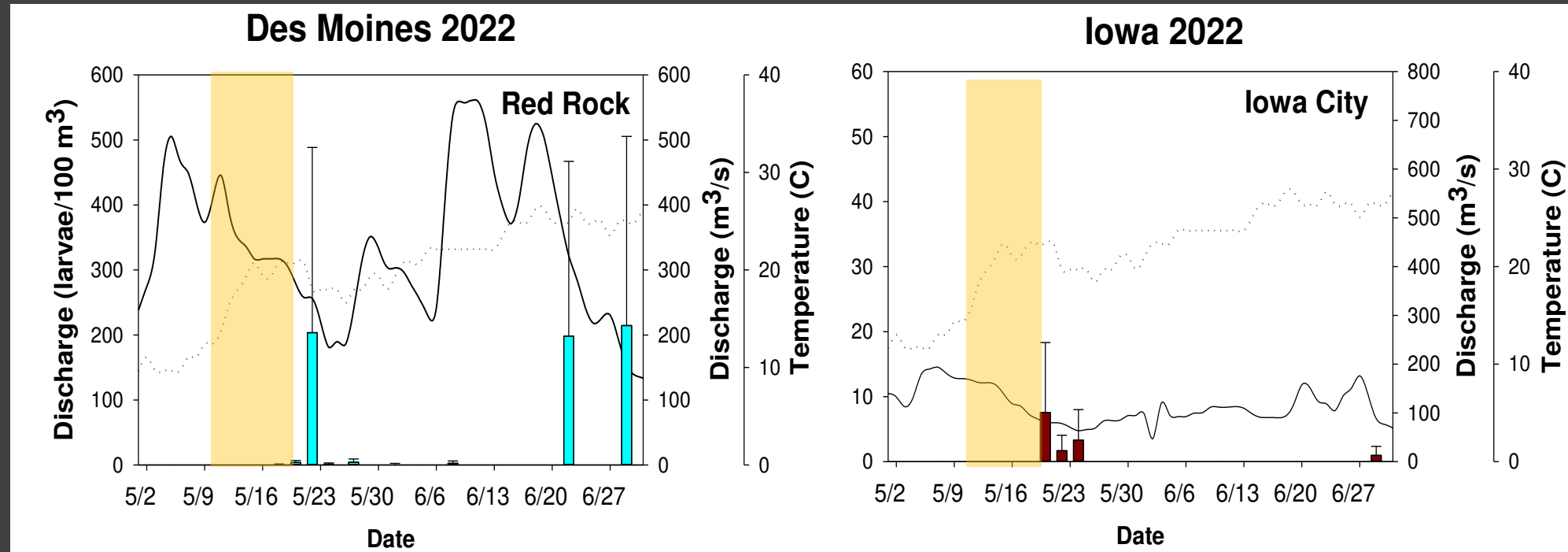


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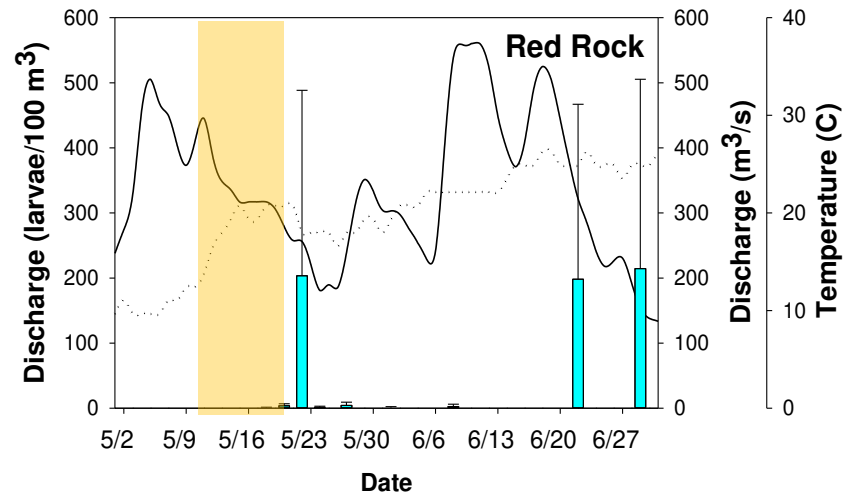
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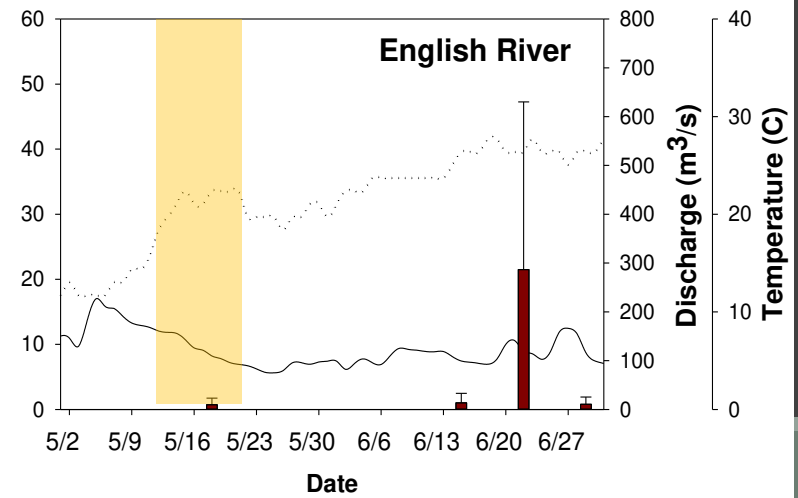
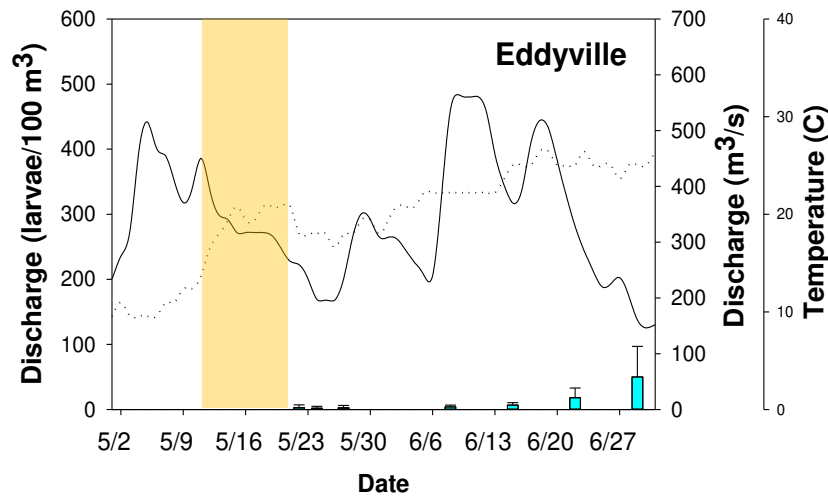
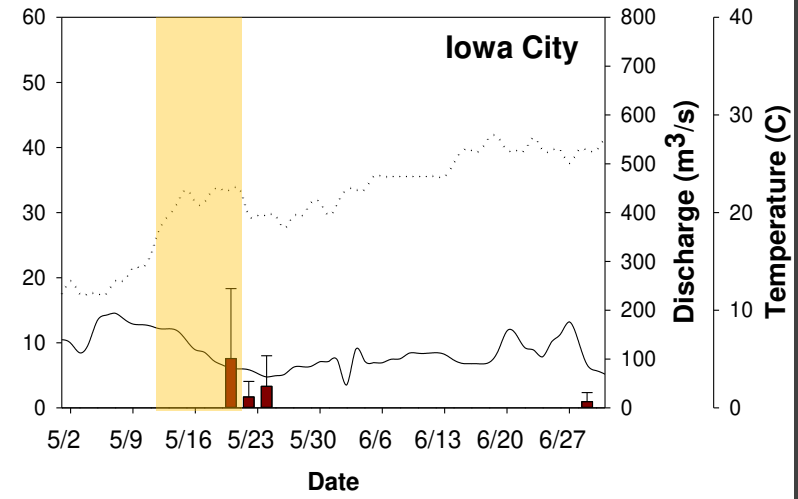


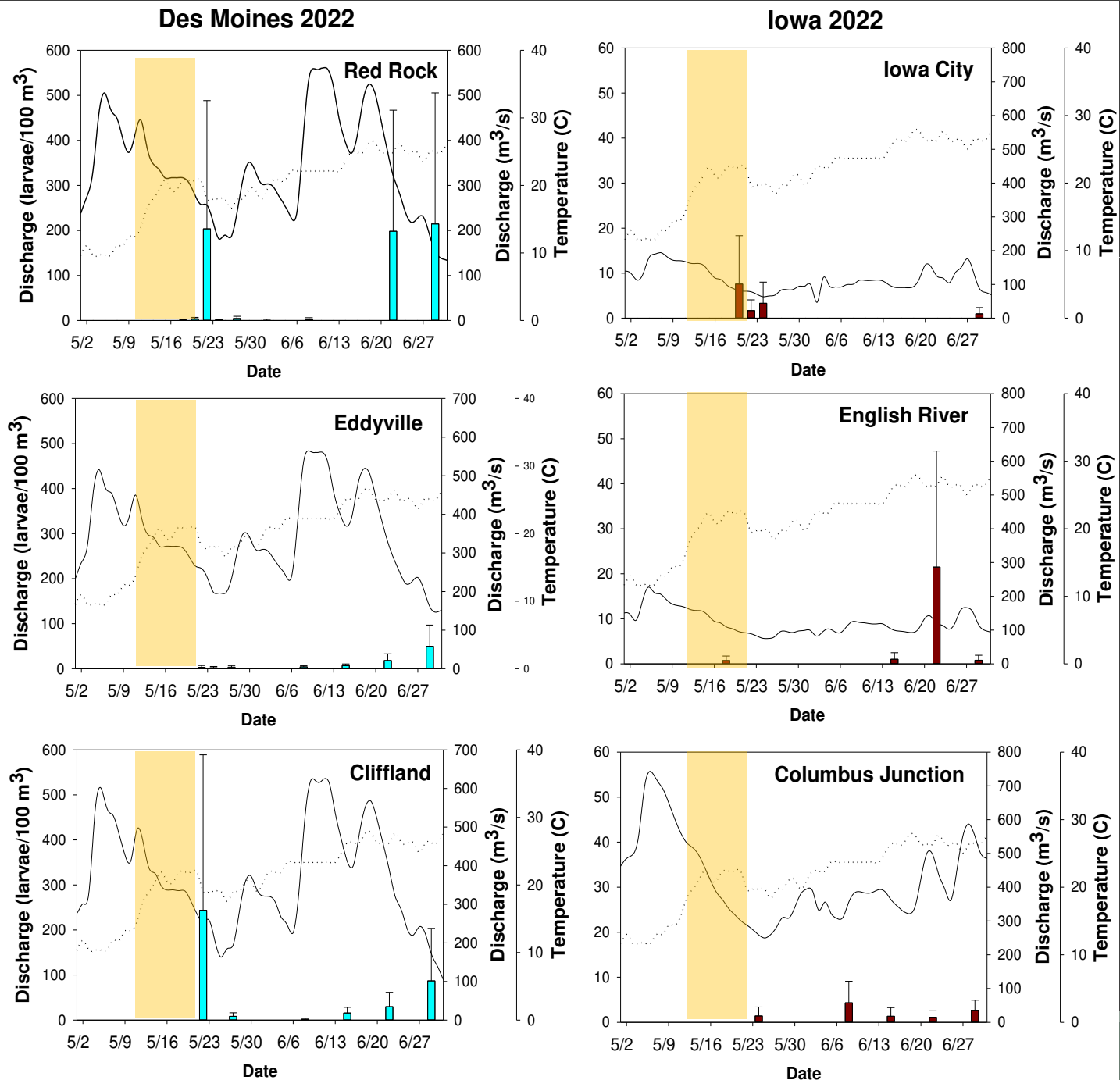


Des Moines 2022



Iowa 2022





How do Cyprinidae respond to environmental factors?



Species	Discharge	Temperature
Sciaenidae	+ ↑	+ ↑
Cyprinidae	+ ↑	+ ↑

Conclusion

- Discharge and Temperature appear important for fish reproduction
 - Experimental pulse may be beneficial for some species
- Different spawn duration and timing for each species



Future Research

- Model effect of flow and water temp on larval fish densities
- Model factors influencing larval Catostomidae and Sciaenidae growth
- Determine how flow and water temp affect prey consumption
- Does reproduction equate to recruitment?



Summary

- Experimental pulse beneficial for some fishes
 - Species respond differently
 - Certain species benefit depending on flow timing
- Higher flows trigger larger response
- High pulse difficult with environmental conditions
 - Drought reduces reservoir storage for reservoir release